Unit 9
Day 4
Variation

Direct Variation:

If y varies directly as the nth power of x or if y is directly proportional to the nth power of x, then $y=kx$. Where k is the constant of variation (proportionality).

Ex1: Write the equation
r is directly proportional to a with a constant of variation of 16.

$$r = 16a$$

Ex2: Write the equation

a varies directly with b with a constant of variation of $\frac{3}{5}$.

$K = \frac{3}{5}$

$$a = \frac{3}{5}b$$

Inverse Variation:

If y varies inversely as the nth power of x, or If y is inversely proportional to the nth power of x, then $y=\frac{k}{x}$.

Ex1 : Write the equation
If b varies inversely as r with a constant variation of 2.6.

$$b = \frac{2.6}{r}$$

Ex2: Write the equation: y varies inversely as x^3.

$$y = \frac{k}{x^3}$$

Joint Variation:

If y varies jointly with the nth power of x and z, then $y=kx^nz$.

Ex1 : Write the equation
w varies jointly with c and f^2 with a constant of proportionality π.

of

$$w = cf^2\pi$$

$$w = \pi cf^2$$

Ex2: Write the equation

D varies jointly with r and t with a constant of variation of 1.

$$D = rt$$

Ex3: Write the equation

r is proportional to x^2 and inversely proportional to y.

$$r = \frac{kx^2}{y}$$

Write each formula as an English phrase.

Ex1:

$C=2\pi r$ where c is the circumference of a circle of radius r.

The circ. varies directly w/ r w/ a COV of 2π

Write each formula as an English phrase.

Ex2:

$r = \frac{d}{t}$, where r is the average speed when traveling d miles in t hours.

rate(r) varies directly with distance (d) and indirectly with time (t)

Write each formula as an English phrase.

Ex:3

$s=kx^3$, where s is the strength of a muscle that has length x.

Strength (S) is directly prop. to the cube of the length of a muscle (x) with a constant of variation of K.

Solve each variation problem:

Ex1:

If m varies directly as x and y, and m = 10 when x = 4 and y = 7, find m when x = 11 and y = 8

$m = kxy$

$10 = k(4)(7)$

$10 = 28k$

$k = \frac{10}{28} = \frac{5}{14}$

$\boxed{m = \frac{5}{14}xy}$

$m = \frac{5}{14}(11)(8)$

$\boxed{m = \frac{220}{7}}$

Ex2:

What happens to y if y varies inversely as x, and x is doubled?

$$y = \frac{k}{x}$$

$$y = \frac{k}{2x}$$ double x

y is cut in half.

Ex3:

What happens to A if A varies jointly with b and h if b is quartered and h is doubled?

$A = kbh$

$A = k\left(\frac{b}{4}\right)(2h)$

$A = \frac{kbh}{2}$ A is halved.

Lets apply what we have learned.

The pressure of a compressed gas is inversely proportional to its volume according to Boyle's Law. A pressure of 40 pounds per square inch is created by 600 cubic inches of a certain gas. Find the pressure when the gas is compressed to 200 cubic inches.

let p = pressure ($\#/in^2$)

V = volume (in^3)

$p = \frac{k}{V}$

$40 = \frac{k}{600}$

$k = 24{,}000$

$p = \frac{24{,}000}{V}$

$p = \frac{24000}{200}$

$p = 120 \ lb^s/in^2$

Hooke's law for an elastic spring states that the distance a spring stretches varies directly as the force applied. A force of 30 pounds stretches a certain spring 5 inches. Find how far the spring is stretched by a 50 pound weight.

let distance = d (in)
force = f (lbs)

$d = kf$

$5 = 30k$

$k = \frac{1}{6}$

$d = \frac{1}{6}f$

$d = \frac{1}{6}(50)$

$d = \frac{25}{3} = 8\frac{1}{3}$ in

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